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## BIOCHAR IN THE WOODS: WHAT TECHNOLOGIES ARE BEST FOR SMALL SCALE PRODUCTION?

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VISIT...

LANZAROTE  
*Caliente*.COM



# Natchez Fire, Rogue Siskiyou NF

Ignition, July 15, 2018

Aug 1, the view  
from my deck...





A photograph showing a forest landscape. In the foreground, several tall, thin pine trees are visible, some with reddish-brown trunks. A thick plume of white smoke or mist rises from the forest floor, partially obscuring the background. The background shows more forested hills under a hazy sky. The overall scene is misty and atmospheric.

**View from my deck: October 2009.  
Smoke fills the air from hundreds  
of burning slash piles – fuels  
reduction project.**



# Jackpot piles burn hot & complete



- Tight piles don't fall apart
- Burn hot in the center
- Burn completely to ash
- **Generate smoke**
- **Burn forest soil**



# Burn pile scars are long-lasting



*Pile burning can create grass and forb-filled openings that often remain treeless for decades, as can be seen in this aerial photo of a 40-year-old regenerating lodgepole pine stand in Grand County, Colorado. (Photo by C. Rhoades)*



Is there another way to treat problem fuels?



# Bottom Lit vs. Top Lit Burn Pile



- Conventional: Flame under cold biomass makes smoke
- Top Lit: Light on top – heat transfers to pile by radiation
- Flame on top burns smoke





1. Light it on top
2. Quench with water to save char





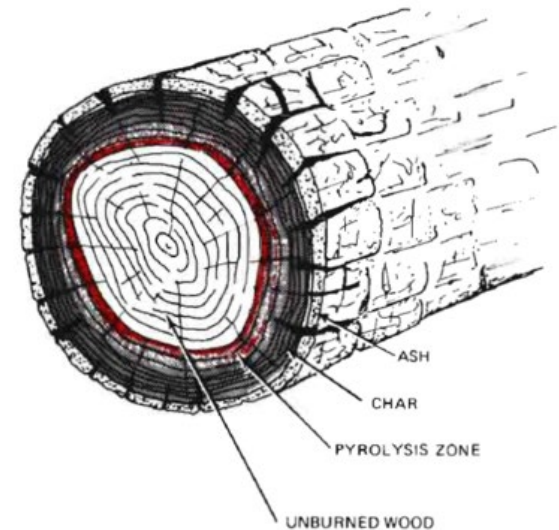
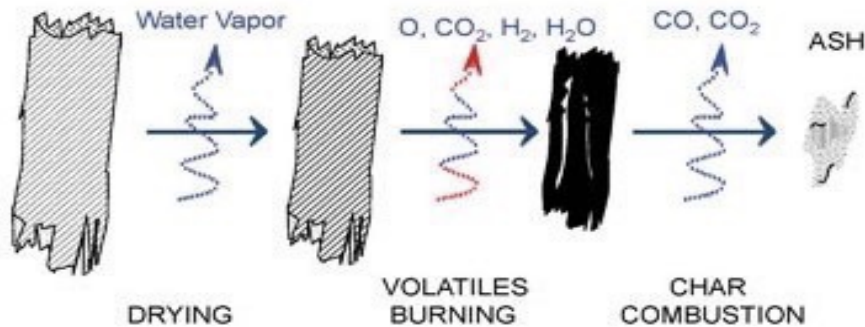




# Flame Carbonization

Making biochar in an open flame

BIOMASS PARTICLE



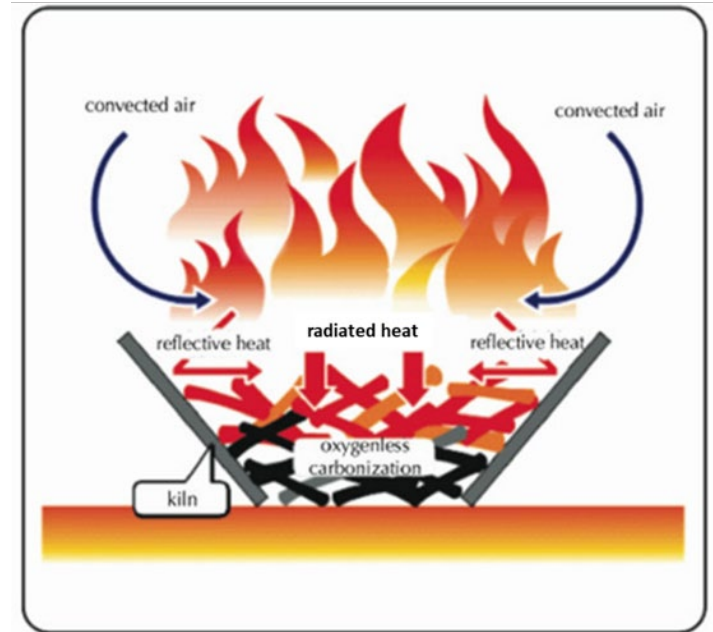
- Biomass burns in 3 stages.
- To make char, stop the process before it goes to ash.



It is all about controlling the oxygen to prevent the final stage of combustion – oxidation of the char



# For greater efficiency: Flame Cap Kiln



Smokeless Carbonizing Kiln Charring Schematic  
MOKI Manufacturing Co. Ltd.  
Nagano, Japan

- Pan excludes air from the bottom
- Flame on top uses up all the oxygen and burns the smoke
- Char is protected from air and does not burn



Can be any shape – pit, pyramid, cone, ring, trench, box



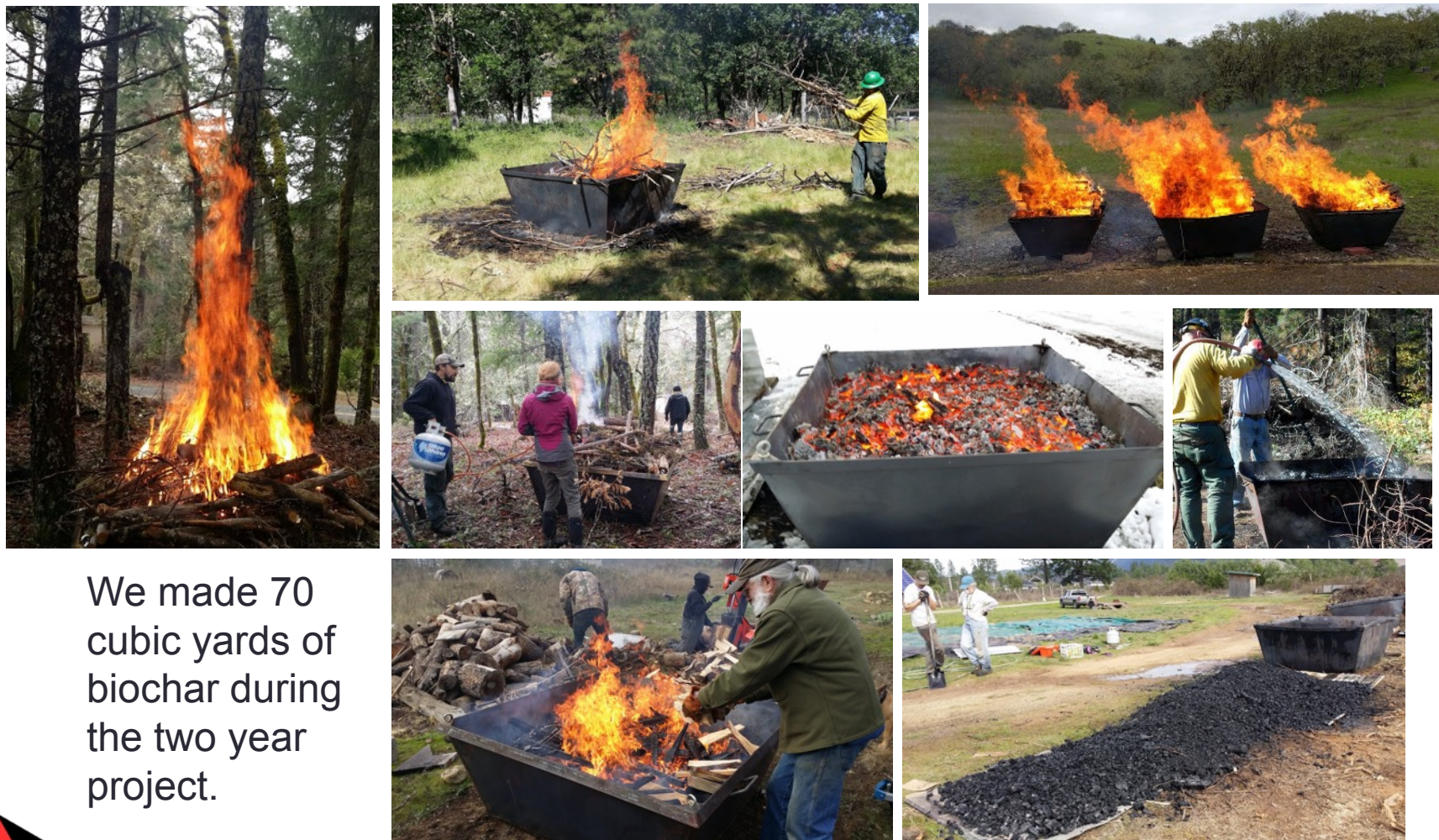


# Super Cheap and Simple: Ring of Fire Kiln





# Umpqua Biochar Education Team (UBET)



We made 70 cubic yards of biochar during the two year project.



**NRCS Conservation Innovation Grant 2015 - 2017**



# Design Parameters - the Oregon Kiln

- Sized for feedstock
  - Logs 4 to 5 feet long
  - Up to 6" diameter
- Portable but durable
  - Less than 200 lbs
  - 14 gauge steel
- Ergonomic for loading
  - Only 2 feet high
- Capacity
  - Makes > 1 cy of biochar in about 4 hours





# How to operate a Flame Cap Kiln



- Pile loosely
- Light on top





# Once the first pile burns down, add more



- Add new material, one layer at a time
- Make sure each layer has the same size material





# Quenching Time



Quench when kiln is full and flame is gone



# Snuff Quenching



Double-walled Ring of Fire Kiln



Oregon Kiln





# Drew Biochar Project – Umpqua Biochar Education Team



- 17 acres of thinning
- Removal of small trees
- Umpqua National Forest



**Stewardship Contract awarded to South Umpqua Rural  
Community Partnership – [www.surcp.org](http://www.surcp.org)**







**Three days, 166 cubic yards of forest slash, 28 cubic yards of biochar**







# Project Planning

Based on Drew Veg Biochar Project

| Project size and volumes  |     |
|---------------------------|-----|
| project size, ac          | 17  |
| tree/ac                   | 800 |
| volume of piled slash, cy | 396 |

| Labor crew size                                             |   |
|-------------------------------------------------------------|---|
| crew size, # of kiln tenders (each tender operates 2 kilns) | 6 |
| crew size, # of machine operators                           | 1 |

**Total crew size: 7 people**





# Labor Time and Machine Hours

| Machines and machine hours                    |   |
|-----------------------------------------------|---|
| loader to place kilns and move slash, hrs/day | 6 |
| water tender for quenching, hrs/day           | 2 |

| Labor hours                              |   |
|------------------------------------------|---|
| crew set up time, hrs                    | 1 |
| biochar burning time per kiln batch, hrs | 4 |
| quenching and unloading, hrs             | 2 |

**Total daily job time, including setup and quench, 7 hours**





# Outputs

| Production volumes                                           |        |
|--------------------------------------------------------------|--------|
| assumed conversion efficiency, biomass to biochar, by volume | 16.70% |
| volume slash consumed per kiln batch, cy                     | 6      |
| biochar output per kiln batch, cy                            | 1      |
| number of kilns                                              | 12     |

| Daily output                      |    |
|-----------------------------------|----|
| total biochar output per day, cy  | 12 |
| total slash processed per day, cy | 72 |

- 5.5 days to process all slash
- 66 cy of biochar produced



# Climate Impact

- Assume one cubic yard of biochar weighs 200 pounds
- 66 cy x 200 pounds = 6.6 tons of biochar
- 6.6 tons x 80% fixed carbon fraction x 44/12 = **19.4 tons of CO<sub>2</sub> sequestered from one 17 ac thinning project.**

**Average American emits approx. 20 tons CO<sub>2</sub> per year**





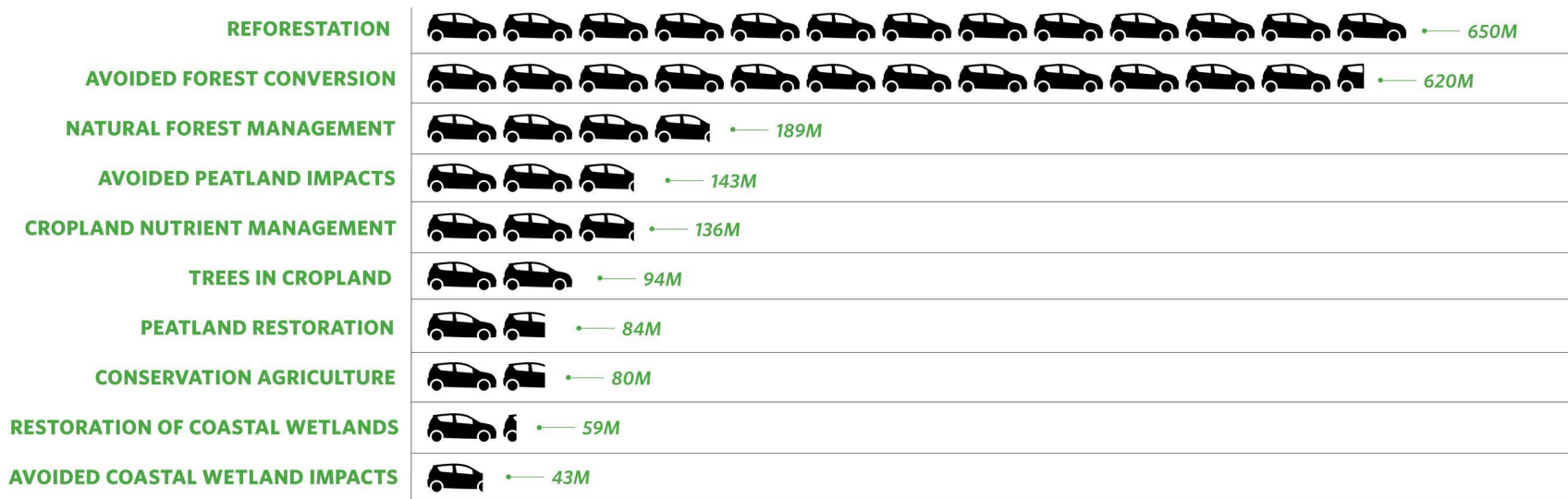
# Restore Nature, Restore Climate



## NATURAL CLIMATE SOLUTIONS

### TOP 10 MITIGATION PATHWAYS<sup>1</sup> WITH CO-BENEFITS

*Natural Climate Solutions have the same impact on emissions as taking millions of cars off the road*



Global Mitigation Potential: Approximate Number of Cars Removed Each Year in Millions

= 50M cars  
<sup>1</sup>Cost-Effective



## We need to Scale It UP!

# Big Box Biochar

Yew Creek Land Alliance, OR



Menoken Farm, ND





# GO BIG – Boots on the Ground



# Civilian Conservation Corps

- President Franklin Delano Roosevelt proposed the CCC program to Congress on March 21, 1933:

*I propose to create [the CCC] to be used in complex work, not interfering with normal employment and confining itself to forestry, the prevention of soil erosion, flood control, and similar projects.*





# Carbon Conservation Corps

- A service year for young people
- Improve forest health and protect communities from wildfire
- Pay them to sequester carbon in biochar
  - PHYSICAL FITNESS
  - A SENSE OF PURPOSE
  - HOPE FOR THE FUTURE



Planting trees in biochar – Ashland Forest Resiliency Project



# Cut, Pile & Burn vs Cut, Char & Quench

| Item                                                         | CP&B          | CC&Q          |
|--------------------------------------------------------------|---------------|---------------|
| Cut (chainsaw work)                                          | \$350         | \$350         |
| Pile (5-8 piles/hr per worker)                               | \$600         |               |
| Burn (20 piles/acre, using drip torch)                       | \$150         |               |
| Biochar Kilns (3 - 4 kilns per acre, 1 person feeds 2 kilns) |               | \$600         |
| Quenching water (water truck & operator)                     |               | \$150         |
| <b>Total cost/acre</b>                                       | <b>\$1100</b> | <b>\$1100</b> |





# Growing Number of Projects and Partners

- NRCS
- USFS
- USDA-ARS
- Oregon Department of Forestry
- North Dakota Forest Service
- Nebraska Forest Service
- Kansas Forest Service
- Utah State University Extension
- Oregon State University Extension
- South Umpqua Rural Community Partnership
- Long Tom Restoration Council
- Yew Creek Land Alliance
- Illinois Valley Community Development Organization
- Two Rivers SWCD
- Ridge to Reefs



Charring Pinyon-Juniper in Utah





# Questions?

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